Distribution of Planetary Nebulæ (○).

	V.L. 10° broad	V.L. 30° broad.
North of V.L.	16	9
In V.L.	9	21
South of V.L.	9	4
	34	34

Whence, in accordance with the previous views, the planetary Nebulæ may be classed with the Clusters as regards their arrangement and distance from us, and are to be considered as the gaseous globes belonging to our *Via Lactea*, which therefore retains its character as essentially a stellar Nebula, forming with the *Nubeculæ* and the 4100 (= 262 + 12 + 80 + (2351 − 16) + (73 − 9) + (1356 − 9)) Nebulæ, the entire visible universe.

It will perhaps be sufficient if, without advocating the correctness of the previous conclusions, we are led to undertake any rational course of systematic investigation. The questions as to the spectra of the planetary Nebulæ, the resolvability of the Nebulæ in the neighbourhood of the *Via Lactea*, and the condensation of Nebulæ around the poles of that band, seem worthy of special study.

January 1867.

On the Estimation of Star Colours. By Sidney B. Kincaid, Esq. (Abstract.)

The author remarks that with the exception of the two isolated instances of *Sirius* and 95 *Herculis*, the latter of them due to the researches of the late Admiral Smyth and the Astronomer Royal for Scotland, no crucial example of the change of the colour of a star has been determined; although there is every reason to believe that such objects vary as well in their hues as in their apparent brilliancies. That Physical Astronomy, which has made such strides in relation to the "Variables," has done so little in the matter of sidereal chromatics is certainly not owing to any lack of interest on the part of the latter subject of inquiry, but is owing to the difficulties that beset any attempt at accurate chromatic observation. Until the publication of the late Admiral's last work, which was specially devoted to the "Colours of Double Stars," no general system for reducing such observations to permanent record in connexion with perpetual standards of comparison had been introduced; and although a great step was taken by the suggestion to use a universally recognised scale of colours as a point of reference—for which aim was given a chromic plate in the book,—coupled with the mentioned use by Mr.

Huggins of chemical solutions as such standards, many hindrances were left remaining, and in the great loss by Admiral Smyth's death shortly afterwards was probably included much further progress towards their removal.

The only instrumental means described by him, the photometrical measurement of the spectrum of the star so as to determine the lucidity of its different sections, is objectionable, as well by reason of its exceeding dependence on the occurrence of opportunities of weather, not only "fine," but "superlatively fine," as by reason of the great and numerous difficulties which render the application of it almost impracticable. The object of the author is to describe an apparatus for the purpose of determining star colours, by which the tints of the fixed stars may be exactly recorded relatively to standards easily reproducible by any observer, with any kind of telescope, any number of years hence, and that by a contrivance the manipulation and reading of which is as easy as the plans now usually adopted for photometric estimations. But he first recapitulates the causes of error which particularly belong to this kind of research. These are—

1st. Personal Equation :—including therein three heads, which, although properly so described as belonging entirely to the personality of the observer, are actually distinct, viz.:—A. That insensibility of the eye to the varieties of colour, which in its most extreme form is colour-blindness. B. Inability of the memory to retain exactly the impression produced by a certain tint, so as to be capable of reproducing and identifying it at a subsequent period. C. Personal difference in the habit of describing the impression of a particular colour.

2nd. Atmospheric Equation :

3rd. Instrumental Equation. Good achromatic refracting telescopes are open to little imputation of deceit as regards the exhibition of the colours of celestial objects ; but the case is far otherwise with reflectors. The prevalence of excessive redness among Sir W. Herschel's chronicles of sidereal chromatics has long given rise to the opinion that the speculum metal misled him in this respect ; and in the same way, silvered glass mirrors are not (without due correction) reliable in any case where the colour of an object is to be accurately depicted.

4th. Standard of comparison. The requisites in such are that it shall afford the exact shade of colour of the star in connexion with which it is to be used, so that such tint shall be easily reproducible with precision by any observer at a future time from the information transferred by the ordinary use of language and that it shall be suitable for comparison with telescopic images. A painted scale like that given in *Sidereal Chromatics*, by Admiral Smyth, is, on account of its opacity of colour, objectionable, and can scarcely claim to be considered sufficiently reproducible. Precious stones, though in many respects suitable, are plainly beyond the reach of most

observers; and the only system which appears to possess the requisite qualification is that of chemical solutions before referred to.

The "Metrochrome," which it is the author's object to describe, is shown in side-section and by a face-view in two figures given in the original paper. It consists essentially of three parts: 1st. A lantern for the production of a constant light; 2nd. A contrivance for imparting to that light the necessary colour, and so arranged that the proper tinge once produced, a record of it can be obtained so as to enable its reproduction at any time; 3rd. Apparatus to throw that coloured light into the field of the telescope as an artificial star which can thus be viewed side by side with the image of the real one. The source of light is a very fine platinum wire, rendered incandescent by a current of electricity transmitted through it from a Smee's battery of two cells. The platinum wire is brought into the focus of a lens so that the rays of light from the lantern issue parallel, and therefore come to a focus, after passing through the object-glass of the telescope, at the same distance from it as those emitted by a star. The chromographic part of the apparatus consists of a drum rotating about an axis. The drum has in it six equidistant radial openings; the alternate three of them transmitting the normal light of the lantern; the other three constructed so as to admit flat-sided stoppered bottles containing chemical solutions of different colours. The outer edge of each of the last-mentioned apertures is graduated into ten parts, and each of them can be wholly or partially closed by means of a radial shutter; the other three apertures can be simultaneously closed, wholly or partially, by a triune radial shutter; the edge of one of them is divided into ten parts, and as all are equally affected by the movement of the shutter, the reading applies to the three openings. The drum is made to rotate so as to bring successively the different apertures in front of the lantern; and, when the rotation is sufficiently rapid, the impression of colour produced on the retina of the eye will be that of a colour compounded of the colours of the solutions in the three alternate apertures, diluted by the white light transmitted through the other three alternate apertures. By a proper selection of the solutions and adjustment of the magnitude of the several apertures by means of the shutters, it will be possible to produce the exact colour of a particular star; and then the record of the solutions employed, and of the dimensions of the several apertures, will enable the exact reproduction of such colour at any future period, for comparison with the then colour of the star in question. The remaining part of the apparatus is a contrivance for throwing the beam of coloured light into the telescope, so as to produce, as already mentioned, the image of an artificial coloured star.
